Yuntech EE - Signals and Systems Midterm Examination

Name: _____   ID No.: _____   97/11/11

(Total 120 points!)

1. (20%) Please identify that the flowing signals are continuous-time or discrete-time. (a) Dog's barks; (b) a panting; (c) a sound track recoded in a cassette; (d) a webcam image.

2. (10%) Please identify that which equation is for **total energy** and the other is for **average power** of a discrete-time signal $x[n]$ over an infinite interval.

$$(a) \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x[n]|^2, \qquad (b) \lim_{N \to \infty} \sum_{n=-N}^{N} |x[n]|^2$$

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3. (15%) Please determine (**and also state the reasons**) whether (a) a discrete-time system $y[n] = x[n^2]$; (b) a continuous-time system $y(t) = \cos[2x(t)]$; and (c) a continuous-time system $y(t) = x(t-2)$ is **time-invariant** or not.

4. (20%) Let $x(t) = u(t-3) - u(t-5)$ and $h(t) = e^{-3t}u(t)$. Compute (a) $y(t) = x(t) * h(t)$ and (b) $g(t) = \frac{dx(t)}{dt} * h(t)$.

5. (20%) Please draw the block diagrams of two difference equations: (a) $y[n] = ay[n-1] - bx[n]$; (b) $y(t) = \int_{-\infty}^{t} [bx(\tau) + ay(\tau)]d\tau$

6. (10%) Determine (**and also state the reasons**) whether or not each of the following continuous-time and discrete-time signals is periodic. If the signal is periodic, determine its fundamental period. (a) $x(t) = \sin(2t - \frac{\pi}{3})$; (b) $x[n] = \cos(\frac{n}{6} - \pi)$.

7. (15%) For the continuous-time periodic signal $x(t) = 5 + 6\sin(\frac{2\pi}{3}t) + 7\cos(\frac{4\pi}{3}t)$, determine the fundamental frequency w_0 and the Fourier series coefficients a_k such that

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jkw_0 t}.$$

8. (10%) For an input $x(t) = e^{st}$, we can determine the output through the use of the convolution integral, i.e.,

$$y(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau = H(s)e^{st}.$$

Please show that

$$H(s) = \int_{-\infty}^{\infty} h(\tau)e^{-s\tau}d\tau.$$